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FLEXIBLE IT SYSTEMS

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Abstract

Demand of flexibility is emergent in every aspect of life. Flexible information systems, adapted to the rapidly changing business environment, are an old wish of information technology. Inspecting the area of inter-organisation business communication systems (traditional EDI and its children) I found out the main reason of slow intrusion of EDI and other B2B solutions could be found in the lack of flexible systems too.

Because of the possible size this article intends to give a short peek to the idea of the flexible system. Article overviews the main aspects of the flexible system, first of all in sense of information management.

Keywords: flexible system, IT, information management.

1. Introduction: the Origin

To introduce this article dealing with the idea of ‘flexible systems’ the best way is to tell some words about the origin of the idea. My motivations root in historical background.

My research program is titled e-business, more precisely inter-organisational communication systems. The ancestor of all inter-organisational communication systems in e-business is the EDI. It was examined the question why EDI has low penetration. I found out, that the necessary human works to make different IT systems inter-operable is the key factor. New technologies, like XML can add cost and work reducing techniques, but the need of human interaction still remains. As in Professional XML is told [2]: ‘Much of the expense in deploying an EDI system occurs because the problem domain is a hard nut to crack; defining the standards for the messages in the first place takes a lot of time and investment. [...] In fact, the labour cost for training and the development add up to a fraction of the total cost when integrating an EDI system within an organisation. But it is important to note that simply changing the syntax of our messages into XML is not necessarily going to make the development of schemas cheaper.’

An expert can summarise very shortly the reason of low penetration of EDI, or any other B2B connecting solution. As Dave Oppenheim said [3]: ‘Until there is an off-the-shelf solution that self-integrates with any application, it is going to be

hard to just dump EDI', and also adds: 'XML sounds simple, but the fact remains that someone has to do the mapping and the integration work.'

So the focus was directed to the question, what is the reason of the nowadays IT systems' poor interoperable abilities. You can examine this question in many ways. You can deal with this question at technical level, or at semantic level, or at business rules level. But I ask the following question: Why has IT system high *resistance* of changes? The italic typeface shows the relevant word in the previous sentence: resistance. A flexible system has no high resistance up to the modifying.

2. The Definition of Flexible System

After the introduction and discussion of motivations in flexible systems topic, first it has to be declared, what exactly flexible systems mean in this discussion.

2.1. A Far Approach

Let us begin the introduction of term 'flexible system' a little bit far from. Here I cite a short text from a not really scientific literacy. The following citation is from Douglas Adams' famous sci-fi trilogy (which is really a 'pentology'), from the 4^{h} part of cycle titled 'Mostly harmless'. Probably is not usual to cite from a popular book into a scientific publication, but I believe this short conversation forms a very effective example of my flexible system interpretation, and give a good illustration, what I am writing about [1].

'Where just a few moments earlier there had been a smoothly curved black disk, there was now a bird. A bird, hovering there.

[…]

Then the blackness receded and rolled itself up into a ball, and then the blackness was a bird again. It hung in the air in front of her, beating its wings slowly and staring at her.

'Excuse me', it said suddenly, 'I just have to calibrate myself. Can you hear me when I say this?'

'When you say what?' demanded Random[1].

'Good', said the bird. 'And can you hear me, when I say this?' It spoke this time at a much higher pitch.

'Yes, of course I can!' said Random.

'And can you hear me when I say this?' it said, this time in a sepulchrally deep voice.

'Yes!'

There was then a pause.

'No, obviously not' said the bird after a few seconds. 'Good, well, your hearing range is obviously between sixteen and twenty KHz. So. Is this comfortable for you?' it said in a pleasant light tenor. 'No uncomfortable harmonics screeching

[1] One of acting persons of this novel.

away in the upper register?' Obviously not. Good. I can use those as data channels. Now. How many of me can you see?'

Suddenly the air was full of nothing but interlocking birds. Random was well used to spending time in virtual realities, but this was something far weirder than anything she had previously encountered. It was as if the whole geometry of space was redefined in seamless bird shapes.

Random gasped and flung her arms around her face, her arms moving through bird shaped space.

'Hmmm, obviously way too many.', said the bird. 'How about now?.

It concertinaed into a tunnel of birds, as if it was a bird caught between parallel mirrors, reflecting infinitely into the distance.

'What are you?', shouted Random.

'We'll come to that in a minute', said the bird. 'Just how many please?'

'Well, you are sort of …' Random gestured helplessly off into the distance.

'I see, still infinite in extent, but at least we're homing in on the right dimensional matrix. Good. No, the answer is an orange and two lemons.'

'Lemons?'

'If I have three lemons and three oranges and I lose two oranges and a lemon, what do I have left?'

'Huh?'

'Okay , so you think that time flows that way, do you?' Interesting. 'Am I still infinite?' it asked, ballooning this way and that in space.'

2.2. Play with Word 'Flexible'

The keyword of flexible appears in other science areas as well. Not surprisingly one of these disciplines is the cognitive science. Probably one of the most flexible systems in the world is the human brain, more exactly the operation of human brain [4]. One of the top features of the human intelligence is the flexible generalisation skill. The human intelligence can flexibly extract the common characteristic of different objects, and can generalise this characteristic into a higher class.

Also the flexible keyword appears in management sciences, for example in the form of flexible production systems.

The demand of flexibility appears in the private life as well. One century ago it was enough to learn one profession. Nowadays, you have to refresh your knowledge every five years, or more frequently. The rigid knowledge structure is no more vital.

Generally it can be told that demand of flexibility is emergent.

2.3. Definition of 'Flexible'

After this short intro to the term of flexible, let us see the exact definition of flexible. It is important to note the following definition of flexible is the base of the whole

thinking of this article, and my approach of flexible IT systems.

In my opinion the core of the phenomenon ‘flexible’ is something responds to an external or internal power impulse with no break. To fulfil the interpretation, flexibility covers as well that after the power impulse ends the subject of influence can recover to its original shape, or to almost an original one. So flexible means when power impulse stops, the subject of action enables the recovery process. I intentionally do not state automatic, self-moved recovery or self-adaptation to the power-impulse: automatic self-adaptation is a higher level of the problem area. My first defined problem area is the problem of enabling flexibility.

Summing up the definition of flexibility: it means the ability to shape a new form according to the external and internal power impulses. In other words flexibility means the ability of reaction to external and internal changes. Obviously, the external and internal are not clear borders, they are upon the granularity of examination level. The very essence of my definition, that I do not expect automation or self-adaptation at this level of flexibility. To differentiate the base flexibility from the advanced one, furthermore I will use the phenomenon of ‘adaptive flexible’ system for the automatic one.

The following *Fig. 1* shows these two levels of ‘flexible’. The pyramid model intends to show the base and top relation as well.

Before discussing the pyramid model I would like to clarify the meaning of *power impulse* and *shape*. I use this phenomenon in abstract sense. Power impulse stands for all type of activity intends to interact with the system. ‘Shape of system’ stands for the overall description of the structure. Both phenomena are coming from the discipline of physics, and have a concrete meaning, so they can be a good base to introduce an abstract meaning.

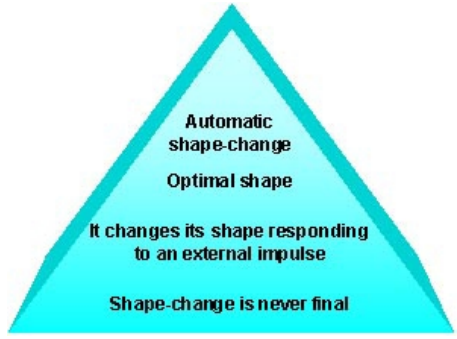

Fig. 1. Pyramid model of flexible term

The very essence of the flexibility by our interpretation is that flexible object shape is never final. This means that the flexible object is forever flexible. It is theoretical, as in real world there are always imperfections, which lead to loss of flexibility. The most common example is even the best quality flexible steel can break finally.

The next layer of the flexibility is that the flexible system responds to external and internal power impulses changes with changing its shape.

The more advanced level of flexibility, when the system always forms the best shape according to all external and internal power impulses. The definition of this layer implicitly means that non-optimum shapes are also allowed.

And finally at the top of all layers, there is the ability of automation.

It is important to declare the main categories of power impulses, regarding the flexibility. For example steel behaviours flexibly up to power impulse, but does not do up to heat impulse: it follows its environment temperature. But the human body behaves in flexible way up to heat impulse: it responds to it by changing the internal power generation level. In the case of IT systems the main categories of flexibility are the human interactions, and the other IT systems interactions.

Also there is a limit of flexibility. If the power impulse is higher or lower what system can tolerate, the system responds with a no flexibility. Usually these cases end with irreversible run.

3. Similar Approaches of Flexibility in IT

In information technology there are other approaches for the flexible systems. Despite these entire schools target to achieve a flexible system, there are differences.

The every day practice is the usage of parameters. The definition of parameters is determined in the phase of requirement analysis, and physical system design. Parameters reflect to business requirements and technical requirements, and predictive guess. The quite usual problem is the number of parameters. A high number of parameters enables quite flexible operation, but it is hard to manage. A high number of parameters leads to the very high number of parameter combinations, but only a few ones are operable. It means that an additional engine to check parameter value constellation is highly recommended, but it is hard to implement. So a high number of parameters determines a large state space, but as only few ones are useful, leads to an unstable system.

Another approach is creating precise and strict algorithms to convert requirements into models, and finally to program code. The advantage of this approach is the ability of high quality software. But the disadvantage of this method is the lack of ability to respond changes, in my opinion. If there is a change, probably the whole process can run very fast, but requires IT knowledge and recreates specialised, rigid components. These approaches run under the umbrella of formal methods [5]. Formal methods cover several methods, like Abstract State Machines (ASM), which is strongly related to self-configured devices.

Yet another interesting area is titled ‘self-configurable systems’. These systems are interesting first of all in telecommunication, where the emergence of mobile communication devices, and mobile computer networks, initiated demand for services in mobile equipments to avoid users from configuring devices to the current network conditions. One of top research sites of this trend is British Telecom research centre. BT actively uses the approach of inspecting natural systems that have

already solved analogous problems, and are applied in telecommunication networks [6].

Another approach is labelled with ‘adaptive intelligent systems’. This approach is presented mainly in fields of robotic.

4. Principles of Flexible Systems

There is a solid foundation of our approach of flexible system. This foundation is the system theory [7].

The system theory states in our understanding that the essence of the system is not the components constitute the system, but the connections between the components. Therefore systems can behave very similarly despite of main differences in their compositors.

Based on our research it is stated that the key of the flexible systems is the view that the behaviour and key properties of a complex system are determined not by the building blocks of the system, but by the connections between them. The flexibility in this sense means the ability to change internal connections. Changing internal connections results in a new form, new behaviour. The initiator of the change is always an external impulse, or in other words a change in the environment.

Let us pick an example from the material science. If you get a piece of steel, and press it, it will bend flexible. The same piece of steel forms another shape according the power impulse(s). The same atoms like before constitute the piece of steel. The difference is that atoms constitute another geometrical settlement. The key change is in the connection between the atoms, as they form a new settlement in the space.

Another example is given from the natural language. Let us see the following two sentences:

(1) John eats an apple.
(2) An apple eats John.

The two sentences mean an opposite in sense of who/what eats what/who. The constituting elements of the two sentences are obviously the same. The difference is again in the connection relations between the elements.

Here is a very analogous pronouncement from HAUSER [8]: ‘Whenever nature has created systems that seem to be open-ended and generative, they have used some kinds of systems with a discrete set of re-combinable elements.’

5. Vision of Effects of Flexible Systems

With a big jump, do not care about how we can achieve a flexible system, but imagine that we have one. It is also interesting and important where we would arrive, if we do a flexible system. The following chapter would like to outline, what kind of changes a flexible IT system can occur. Also this thinking on future can show.

5.1. Supporter Technology

There are several possible supporter technologies to implement a flexible IT system. For example agent technology can play a high role.

XML and related technologies as hardware and system independent presentation of data can be a strong backbone of the flexible systems. XML based database engines are quite important due to ability of them to store data in flexible structure.

The object-oriented view of information technology is a solid base for the building system from highly recombinable blocks.

5.2. Engineering

Obviously a system structure, which can be modified easily even by business users requires new methods for system engineering. The classic way of engineering, starting from the requirement engineering through modelling and code development, would be changed.

If the business user can build and can adjust unaided the required system, the vendor role can decrease. Another question is the methodology. Requirement engineering has many methodologies today (i.e. related parts of RUP, related parts of SSADM, Zachman framework, etc.). The requirement engineering is very important as the first step of modelling reality. Nowadays, IT system development really means modelling of reality and recreating the reality after. The more detailed model of IT system engineering is presented by *Fig. 2*.

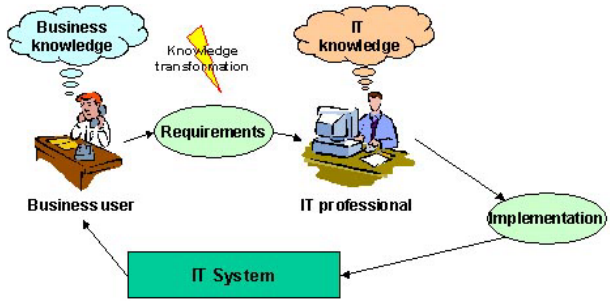

Fig. 2. Traditional IT system engineering

Because of the necessary conversation between business users and IT professionals the traditional IT system engineering makes knowledge transformation between business knowledge and IT (technical) knowledge. As any knowledge type converting it can make distortions, they lead to malfunctions in IT system, and make business users unsatisfied. In addition misunderstandings lengthen development time and obviously cost a lot.

Fig. 3 shows the proposed engineering method for flexible system.

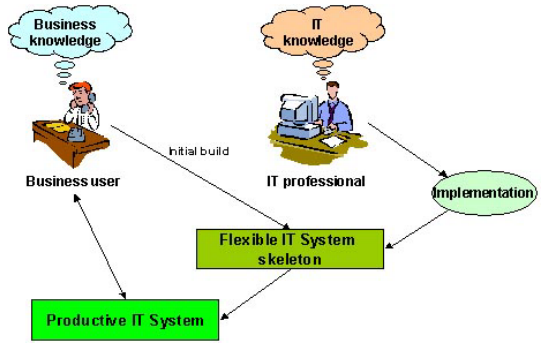

Fig. 3. Proposed engineering of flexible system

The main difference to engineering method of traditional systems is that requirement loop is closed, starts from business user and ends at it as well, without involved other participants.

5.3. Business Revenue Model

As the next section shows, building an IT system by a flexible system, requires a role-casting from IT vendors and from users as well. On the other hand the essence of flexible system concept is that business user can build a system oneself, without external assistance. The lack of external sources means that there would be no task for IT vendors.

Fig. 4 illustrates the process model of traditional engineering with marking the revenue points.

The next section based on a ‘what-need-to-do’ activity model introducing the resolution of the revenue model changing.

5.4. User Roles

The flexible system implies a changing user role as well. While nowadays the end user has a quite passive role – explains its requirements, then test the system, claims the unacceptable functions or solutions, finally accepts a more or less suitable system, so there are no activities to explicitly form the system for them – then in the case of a flexible system users role is to build and maintain its system.

This means a new user attitude, a new user type of user knowledge. However, the knowledge maybe not brand new, but a new combination of existing knowledge parts. Keep it in mind: the flexible system interface to business user intending to use an interface is common for business experts.

It is a very often-stated truth that business systems are complex systems. Therefore supporter IT systems are complex too. If you build up a highly flexible

system, which supports flexible systems obviously the flexible system would be complex as well, even the flexible system has a hierarchical interface to manage it. My proposal to overcome the problem of complexity is the *step-by-step occupation model*. Occupation in this context means the occupation of the system, the time while user knows the system functions, and becomes experienced with it. So occupation means not only a lexical type knowledge, but stronger: skills with the system.

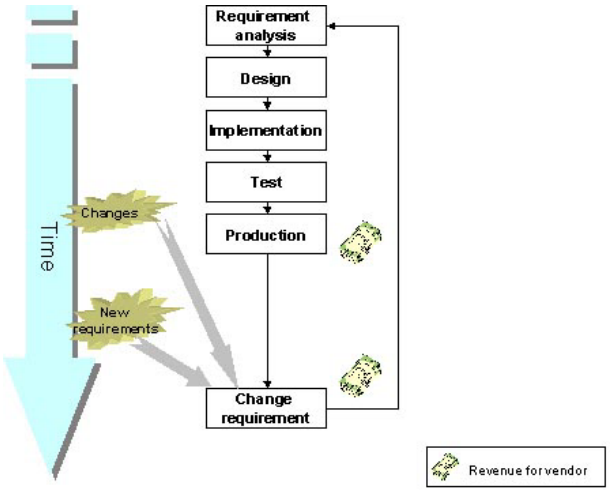

Fig. 4. Business revenue model of traditional IT systems

The idea of step-by-step occupation model is based on one of our survey. A business user told that learning the whole set of functionals of Microsoft Excel had taken half a year, but he was happy with it, because Excel covers all of his analysis requirements, and the most important, he can explicitly and quickly control the content of the analysis. Obviously, this business user uses Excel to solve problems in a special business area. On the other hand he had to learn those functions and the methods of Excel which had not been familiar with it.

Concluded from this experience, a step-by-step occupation means strong support from system vendor at the start, and this support is withdrawn step-by-step as the user knows more and more about the system. This is quite different from the nowadays practice. *Fig. 5* and *Fig. 6* show the difference between the existing and the proposed practice.

Fig. 5. User and vendor activities of traditional IT system

Fig. 6. Step-by-step user occupation of system model

The step-by-step model shows the proposed revenue model as well. IT vendors can make revenue at one point from selling flexible system skeleton, and after it from support fees, and on long time horizon from education and consulting services. As well as you cannot say the technological evolution would be frozen at today's level, so new releases need for the newer and newer technologies.

6. Conclusion

A strong demand for flexible systems is an unquestionable fact. But as this article intends to show, there are several issues needed to solve achieving a flexible system. Obviously, there are technological, information science related tasks to do, but there are many information management related issues to overcome. To implement a flexible system needed to new engineering methodology, new thinking about revenues at IT vendor side, and new models for IT costs at the user side. The summing up flexible systems requires a new attitude. And last but not least there are several things to do till the first flexible system.

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